

Intersubband Raman Lasing in Quantum Well Structures

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The quantum cascade laser (QCL) represents one of the most exciting semiconductor devices both from the viewpoints of basic physics and potential applications. Extremely impressive and rapid development has been made in Bell Labs since the first announcement in 1994. The QCL is an electrically-pumped diode laser based on intersubband transitions in quantum wells. Recently, an optically-pumped intersubband laser has been achieved by Julien's group at University of Paris-sud — termed the quantum fountain laser (QFL). In this presentation we report on experimental evidence of an optically-pumped infrared intersubband laser based on a resonant Raman process. The Raman laser has been realized in an artificial GaAs/AlGaAs 3-level quantum-well structure. A CO₂ laser in resonance with the 1-to-3 level transition is used as the pump, while the lasing emission occurs via the 3-to-2 level transition. The 1-to-2 level spacing is designed to be in resonance with the AlAs-like longitudinal optical phonon mode, favoring the Raman process. This work presents an alternative mechanism for realizing intersubband lasers and opens up new possibilities in reaching the far infrared region and achieving room temperature operation.